G10 A Fractal Analysis of Bone Trabeculae—Artificial Intelligence in Identification

Sylvain Desranleau, DMD, Ordre des dentistes du Québec, Montréal, PQ H3B 1X9, CANADA; James McGivney, DMD, St. Louis, MO 63119*

Learning Overview: After attending this presentation, attendees will have acquired new information regarding the use of mandibular trabecular bone patterns to establish positive identification.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by establishing a method of calculating the significance of mandibular trabecular bone patterns in arriving at a positive identification.

According to Berkeley's Orthopaedic Biomechanics Research, the trabecular bone can be classified as a porous cellular solid, consisting of an irregular 3D array of bony rods and plates, called trabeculae, which are composed of a calcified matrix. Bone marrow fills the spaces of the pores. In addition, because all free bone surfaces are covered with bone cells, bone is a living tissue that is self-healing and has the ability to adjust its morphology in response to changes in its mechanical environment, the so-called but poorly understood phenomenon of bone remodeling. As such, the mechanical complexity of this two-phase biological tissue surpasses any engineering material, making it a fascinating subject of study regardless of clinical applications.

The process of dental identification compares postmortem to antemortem data. It involves the analysis of different factors such as: the presence and absence of teeth, crown, and root morphology and their interrelationships, the evaluation of the periodontal status, the type and extent of restorative, endodontic, fixed, removable, and implanted materials, tori and sinus configuration, anomalies and pathologies of teeth and bone as well as trabecular pattern morphology.

Few studies have been conducted on the statistical reliability of trabecular bone patterns for identification purpose. Some deal with algorithms, a mathematical expression that produces the answer to a question or the solution to a problem in a finite number of steps. Others deal with fractal analysis consisting of assigning a fractal dimension or other fractal characteristic to a dataset. The theoretical dataset, pattern, or signal extracted from a phenomenon can include natural geometric objects, sound, market fluctuations, heart rates, digital images, molecular motion, networks, etc.

Some of the studies apply fractal geometric techniques to the study of trabecular bone to fractal analysis of radiographs by the assessment of trabecular bone structure and prediction of elastic modulus and strength, to methodological principles for fractal analysis of trabecular bone, to digital image analysis of cadaver mandibular trabecular bone patterns, to fractal dimension and lacunarity analysis of dental radiographs, to technical factors in fractal analysis of periapical radiographs, to the morphodigital study of the mandibular trabecular bone in panoramic radiographs, to fractal analysis of mandibular trabecular bone using the tile counting method, to the anatomical variations of trabecular bone structure in intraoral radiographs using fractal and particles count analyses, to the analysis of trabecular bone using site-specific fractal values calculated from cone beam Computed Tomography (CT) images, and finally to the fractal dimension of the mandibular trabecular bone measured on digital and digitized images.[1-11]

As a continuation of previous research projects, *The Trabecular Bone in Identification*, *The Trabecular Bone in Identification—Algorithms and Fractal Analysis*, *Fractalyse Software—The Analysis of the Trabecular Bone in Identification*, and *Fractalyse Software—The Analysis of the Trabecular Bone in Identification (The Continuation)*, the current research deals with the concept of artificial intelligence in the morphometric analysis and comparison of trabecular bone patterns.[12-16] Outcomes suggest that the development of a new software with a revolutionary approach to handling human trabecular jaws' bone patterns for identification purposes could be possible. This approach would be especially practical in mass disaster situations involving large numbers of edentulous victims and/or with fragmented remains.

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*Presenting Author

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Forensic Odontology, Fractal Analysis, Artificial Intelligence

*Presenting Author